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Question Paper Code : 30926

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2024.

Fifth/Seventh Semester

Mechanical Engineering

ME 8595 — THERMAL ENGINEERING – II

(Common to : Mechanical Engineering (Sandwich))

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Steam table may be permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the effects of friction on expansion of steam?

2. Define critical pressure ratio for the nozzle.

3. What are called supercritical boilers?

4. State the function of Steam trap.

5. Mention the purpose of compounding of steam turbines.

6. What methods may be adopted to prevent erosion of turbine blades?

7. What is topping cycle cogeneration system?

8. List the common fuel used in gas turbines.

9. Mention few applications of refrigeration.

10. Define grand sensible heat factor (GSHF).

PART B — (5 × 13 = 65 marks)

11. (a) A steam nozzle receives steam at 40 bar and 400° C at an initial velocity of 40 m/s. The final pressure of steam is 10 bar. The mass flow rate of steam is 2 kg/s. The nozzle efficiency is 90 %. The cross-section of the nozzle is circular. The angle of divergence is 0°. Calculate the throat and exit diameters of the divergent portion.

Or

(b) Discuss the supersaturated or metastable flow through a nozzle with a h-S diagram.

12. (a) With a neat layout, explain the working principle of electrostatic percipitator.

Or

(b) The following data refer to a boiler trial : Feed water = 700 kg/h, Feed-water temperature = 25° C, Steam pressure = 15 bar, Steam temperature = 300 °C, Coal burnt = 90 kg, CV of coal = 30.500 kJ/kg, Ash and unburnt coal in ash pit =4 kg/h with C.V.= 2200 kJ/Kg, Flue gas formed - 20 kg/kg of coal burnt Flue gas temperature at chimney = 300 °C, Ambient temperature = 30°C. Mean specific heat of flue gases = 1.025 kJ/kgK. Calculate

(i) the boiler efficiency

(ii) the equivalent evaporation

(ii) the percentage heat unaccounted for.

13. (a) What are the various methods of governing of steam turbines? Explain any one with a neat illustration.

Or

(b) Steam at 4.9 bar and 160°C is supplied to a single stage impulse turbine at the rate of 60 kg/min. From there, it is exhausted to a condenser at a pressure of 0.196 bar. The blade speed is 300 m/s. The nozzles are inclined at 25° to the plane of the wheel and outlet blade angle is 35°. Neglect friction losses and estimate (i) the theoretical power developed by the turbine, (ii) the diagram efficiency, and (iii) the stage efficiency.

14. (a) Discuss the techno-economic advantages of cogeneration technology.

Or

(b) Explain the cogeneration systems using the back pressure turbine, with a neat diagram.

15. (a) Discuss in detail about summer air-conditioning system with a schematic diagram.

Or

(b) A refrigerator uses R134a as its refrigerant and operates on an ideal vapour-compression refrigeration cycle between 0.14 MPa and 0.8 MPa. Determine the rate of heat rejection to the environment in kW if the mass flow rate of the refrigerant is 0.05 kg/s.

PART C — (1 × 15 = 15 marks)

16. (a) An R-717 (ammonia) system operates on the basic vapour compression refrigeration cycle. The evaporator and condenser pressures are 0.119 MPa and 1.389 MPa respectively. The mass flow rate of refrigerant is 0.1 kg/s. The volumetric efficiency of the compressor is 84%. Determine the compressor displacement rate. If the COP of the cycle is 2, determine the power input to the compressor.

Saturation in properties of R717 (Ammonia)

Temp. °C	Pressure Mpa	Sp. Volume of vapour m3/kg	Liquid enthalpy kJ/kg	Vapour enthalpy kJ/kg
-30	0.119	0.9638	63.9	1423.6
36	1.389	0.0930	371.4	1488.6

Or

(b) Discuss the effect of sub-cooling and superheating in Vapour Compression Refrigeration Cycle with a neat Schematic.

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